ORIGINAL ARTICLE

Sedentary Behaviour and Sleeping Time of Adolescents in Indonesia: Objective Measurement with Accelerometer ActivPAL

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ABSTRACT

Introduction: Sedentary behavior is closely related to health problems, especially non-communicable diseases (NCD). However, in Indonesia, the total time spent in sedentary behavior has not been quantitatively measured. This study aims to measure the amount of sleep and sedentary behavior in adolescence objectively. **Methods:** This study sample consisted of 47 Indonesian high school students aged between 16 and 18 years old, consisting of 24 males and 23 females. Data on sedentary behavior and sleep time were even-day ActivPAL data. The recording was carried out for 24 hours every day. **Results:** The results showed significant differences in sleep between boys and girls (8.3 + 1.44 vs. 9.3 + 1.41, P <.05). The behavior between female adolescents and males in Indonesia is also significantly different (10.3 + 1.24 vs. 9.3 + 1.37, P <.05). **Conclusion:** Girls spend an average of more sleep per day than boys, and boys' sedentary behavior time is higher than girls'. These findings indicate the need for the promotion of appropriate sedentary behaviours and sleeping time in adolescents.

Keywords: ActivPAL, Sleeping time, Adolescents, Sedentary behaviour

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INTRODUCTION

In 2050, the rate of human growth is expected to increase by 22% from the current total human population (1). Adolescents are estimated to make up 16% of the population (2). Based on these estimates, it is important to prepare a generation that has physical quality because increasing age is in line with the increased risk of contracting non-communicable diseases caused by a decrease in physical quality, which is a challenge for health and social care resources (3). Many recommendations for behavior change in reducing various diseases caused by decreased physical quality in adults have been issued, including by WHO (4). Furthermore, WHO has also made guidelines for physical activity recommendations that must be carried out for each level of age, known as physical activity guidelines for youth, adults, and elderly (5).

To prevent being exposed to various diseases, it is necessary to have a quality body that benefits from healthy movement behaviour, including regular participation in physical activity, a good quality of sleep, and sufficient sedentary behavior. Various diseases such as decreased performance of the heart and blood vessels, DM Type 2, cancer and decreased muscular-skeletal function are some of the diseases that can arise due to lack of physical activity (6–13). Bad quality of sleep and insufficient sleeping time can affect the decline of neurocognitive performance (14) and increase the risk of mortality and morbidity factors that cause various diseases (15). Apart from physical activity and sleep time in recent decades, sedentary behavior has become another risk factor that causes health problems (13,16). Sedentary behavior is defined as sitting (not exercising), leaning, and lying down (posture) with low energy expenditure (17). Activities requiring only 1.0 to 1.5 basal metabolic rate, and positions between lying and sitting, are characteristic of sedentary behavior (18). Energy expenditure of ≤ 1.5

METs, in a sitting or lying position, and not simply the absence of physical activity is a reference for sedentary behavior (19). Sedentary behaviour is also a behavior that occurs at various ages; children, adolescents, and adults (20). Factors that influence sedentary behavior the most in adolescents are screen time in entertainment (watching TV / DVD / Film) and videogames (21,22).

In epidemiological studies, Self-report questionnaires were used to measure sedentary behavior and physical activity (23). Self-reports are effective but tend to overestimate actual physical activity and degrade or reduce the amount of sedentary behavior (24,25). Besides, measurement using self-report has one drawback in measuring mild physical activity because the mild activity is the most challenging category to remember (26) yet is the most frequently done (25,27). To measure energy expenditure and type of physical activity, acceleromotor is considered an effective tool to explore physical activity patterns objectively in more specific objects such as intensity, duration and frequency of physical activity, compared to diaries and surveys (28,29). Accurate measurement of physical activity patterns, sedentary behavior, and sleep time using an objective physical activity monitor (pedometer and accelerometer) has been effectively proven to measure activity patterns (30). In measuring physical activity and sedentary behavior, many studies have frequently used accelerometers (24,25,27–30). However, as far as we are concerned, in Indonesia, there are still very few or even no studies measuring physical activity in adolescents using the accelerometer, especially ActivPAL. The publicly available research on physical activity in Indonesia still uses questionnaires as a measurement tool (31–37). Therefore, this study aims to measure patterns of movement, especially sedentary behavior and sleep time in adolescents in Indonesia.

MATERIALS AND METHODS

Ethical Clearance
This study was conducted according to the ethical clearance guaranteed by the ethics committee for research of the Centre of Research and Community Service, Universitas Pendidikan Indonesia. No. B-1077/UN40.LP/PJ.00.00/2021

Participants
Cluster random sampling recruited participants from several grades and classes at SMAN 3 Ciamis, West Java, Indonesia. Participants in this study were 47 high school students (24 male and 23 female), age between 16 – 17 (M + SD = 17,22 + 0,37). Prospective samples are first given an explanation related to the research, and they are asked to fill out a form of consent. The study also requested schools' consent to participate in this activity. In addition, the study also involved teachers in installing equipment and supervising students' daily lives so that

no students would release the accelerometer during the data recording process.

Data Collection Procedure
Participants were asked to wear an ActivPAL Pal-4 accelerometer activity monitor (PAL Technologies Ltd.) for seven days and not release it even when bathing or swimming to measure sedentary behavior and sleep time. ActivPAL is a small electronic device for recording key activities such as lying, sitting, standing, walking, and cycling. This device contains microprocessors, sensing elements, recording elements, related electronics, and power supplies. This system allows a person's daily activities to be classified every second in terms of time spent lying, sitting, standing, and walking (38). Previous studies have been measured ActivPal™ PAL 4 accelerometer's validity and reliability with concurrent validity R=0.96 (39).

Data Analysis
Data recording from ActivPAL was then downloaded and analyzed for average sleep time and sedentary behavior per day. Average sleep time and sedentary behavior were compared with independent sample t-tests. Statistical data were processed using SPSS 23 software.

RESULT

The recording results using the ActivPAL accelerometer for the next seven days are made to be an average per day. Figure 1 shows an example of data recording of daily activities using ActivPAL. Blue indicates sleeping activity, yellow with blue stripe is lying activity, yellow is sitting activity, pink is motorized riding activity, green is standing activity, red is physical activity of walking / running or other physical activity, and purple is cycling activity. Figure 1 also shows the activities in one day carried out by one participant. From this picture, it is known that in one day the participants did stepping activities (walking / running) 5656 steps, activities from sitting to standing 55 times and Metabolic Equivalent (MET.h) as much as 32.49. Sleep activity is 11.6 hours,
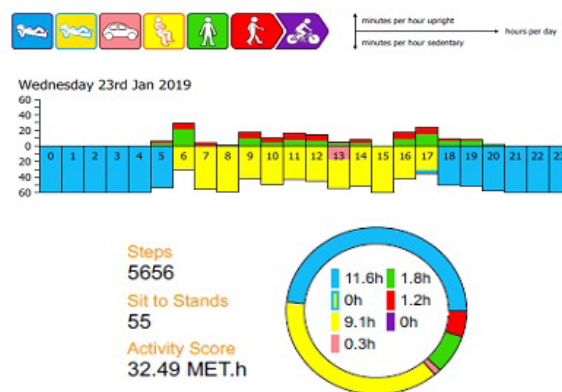
Figure 1: Accumulated Daily Physical Activities

sitting 9.1 hours, standing 1.8 hours (cumulative) and physical activity 1.2 in one day.

Based on the data as shown in table I, it is identified that teenage boys spend an average of 8.3 hours of sleep with a standard deviation of 1.44, while adolescent girls spend an average of 9.3 hours with a standard deviation of 1.41. For a sedentary time, boys spend an average of 10.1 hours with a SD = 1.24, while girls spend an average time of 9.3 hours per day with SD = 1.37.

The lowest sleeping time in boys is 5.54 hours per day, and the highest is 11.80 hours per day. Meanwhile, in girls, the lowest sleeping time per day is 5.20 hours, and the highest is 11.95 hours per day. The lowest time used for sedentary behavior (rest, silence) in boys is 7.88 per day, and the highest is 12.36 hours per day. The lowest time is 7.43 hours per day in girls, and the highest is 13.70 hours per day.

Table I. Descriptive Statistics of Sleeping Time and Sedentary Time by Gender

	Gender	N	M (Hours)	SD	Min	Max
Sleeping Time	Boys	24	8,3	1,44	5,54	11,80
	Girls	23	9,3	1,41	5,20	11,95
Sedentary Time	Boys	24	10,1	1,24	7,88	12,36
	Girls	23	9,3	1,37	7,43	13,70

Based on the results of the independent sample t-test as shown in Table II, it was found that there were significant differences in sleep time between adolescent boys and girls (t = 2.45; p .018). Teenage girls' sleep time is higher than boys', with an average difference of 1.02 hours. Likewise, with sedentary behavior, there were significant differences in sedentary behavior between adolescent boys and girls (t = 2.14; p .038). Teenage boys spend more sedentary time than the girl.

Table II. The Comparison of Sleeping time and Sedentary Behavior by Gender

Variable	t	df	p	MD
Sleeping Time	2,45	45	0,018	1,02
Sedentary Time	2,14	45	0,038	0,82

DISCUSSION

Sleeping time
Sleeping time and sedentary behavior are the focus of this research. The significant difference in the amount of sleep between boys and girls is the result of this study. Adolescent girls spend more time sleeping than boys, but are still in the range of normal sleep recommendations; between 8-10 hours (40). This study's results are in line with the study that states that girls have a significantly more advanced sleep phase than boys and girls have a longer ideal sleep duration than boys (41).

The quality and duration of sleep known to have a positive effect, one of which is learning movement skills (42). Lack of sleep can affect the decline neurocognitive performance (14). Sleeping time is recommended to be sufficient, meaning that it is neither less nor too excessive. Poor sleep habits or excessive sleep will increase the risk of mortality and morbidity factors that cause various diseases (15). Lack of sleep will decrease decision making and cognitive ability (43), memory capacity performance (44) and inhibit behavioral abilities (45).

Sedentary Behavior
Sedentary behavior between boys and girls is significantly different, where boys spend more time on sedentary behavior compared to girls. This result is different from the results of previous studies where Portuguese female students spend more time in a while compared to male (46). This difference is due to geographical and demographic difference between Indonesia and Portugal. Nearly half a day (9-10 hours per day) of 24 hours arespent by high school teenagers in Indonesia, especially West Java, for sedentary behavior. They spend about 42% of the total time of one day or about 63% of their time in sedentary activities.

In line with previous studies that youth, elderly and over spend about 60% of their daily time in sedentary activities. However, in America, before the age of 30, girls sit more than boys, but this pattern reverses after the age of 60 (47). This difference may be influenced by various factors including cultural differences. Sedentary behavior is related to age, socioeconomic class, parent education level, residency, physical activity, alcoholic drinking behavior and obesity (48).

Sedentary Time by Gender
This study revealed that there were differences in sedentary time based on gender. Furthermore, it can be deduced that boy spend more sedentary time than girl. The results revealed that the boy's sedentary time (20.7%) was greater than that of girls (16.1%), but the boys' MVPA on weekends was greater than that of girls. This result in inline with the previous study conducted by Velde and colleague (49). The result showed that boys sedentary time were higher than girls, as well as boys physical activity level were more high than girls. Others study conducted by Myers and colleague (50) show that boys were more physically active than girls. However, regarding sedentary behaviour, girls tend to more sedentary than boys. Therefore, it can be concluded that sedentary behavior between has a different pattern for boys and girls, so different treatment is recommended.

Limitation
The contribution of this study has been to confirm that adolsecent's sleeping time and sedentary behaviour between boys and girls in Indonesia are significantly different. This objectively measure results should have to improve movement behaviour promotion among

adolescent in Indonesia. However, this study has several limitations. First, the small sample size from only one location in this study did not allows generalisability of this result. The second, this study is limited by the lack of information on samples movement behaviours background, for example participation on extracurricular activity. This background may have influenced the results of this study. Lastly, the uncontrolled factors associated with body mass index can be affected this study outcome. Future studies must consider the representative sample, background information, and body mass index characteristics.

CONCLUSION

The results of the research data analysis showed that there were significant differences in the measurement of the amount of sleep and sedentary behavior in girls and boys. Girls spend more of their daily activities for sleeping than boys, and boys spend more time on sedentary behavior than girls. This study outcome can be used to develop targeted interventions to decrease sedentary behaviours and appropriate sleeping time for adolescents, especially boys.

ACKNOWLEDGMENTS

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